

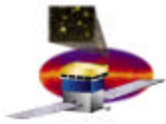
## GLAST Large Area Telescope Calorimeter Subsystem

### 5.0 Crystal Detector Element Overview

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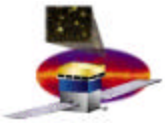


# CDE Outline

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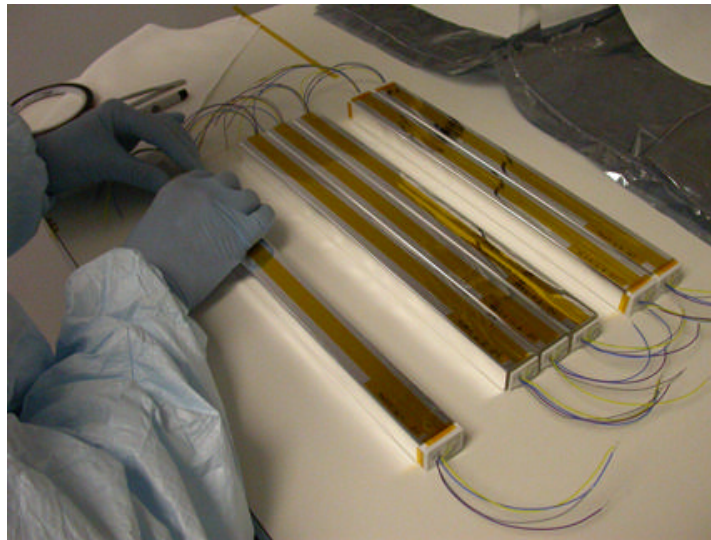
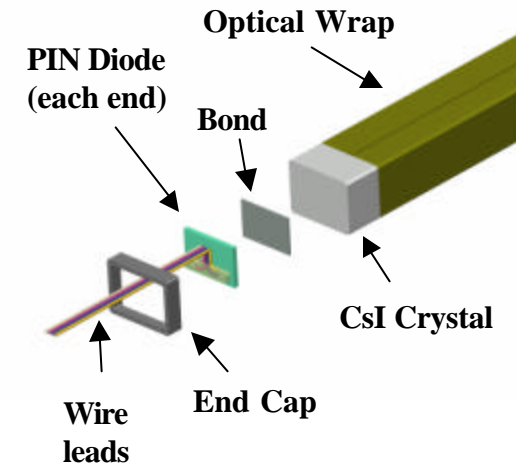
- ❑ **Crystal Detector Element (Spec: LAT-DS-01133-02 )**
  - **Design Drivers** **Eric Grove**
  - **Design Components** **Eric Grove**
  - **Responsibilities & Schedule** **Eric Grove**
  - **Csl(Tl) Crystals** **Leif Nilsson**
  - **CDE Manufacturing** **Didier Bédérède**  
**Philippe Bourgeois**





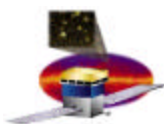
# CDE Design Components

- CDE has four components
  1. CsI(Tl) crystal
  2. Two PhotoDiode Assemblies (PDAs)
    - Hamamatsu S8576 Dual PhotoDiode (DPD)
    - Wire leads, soldered and staked
  3. Wrapper
    - 3M Visual Mirror VM2000 film
  4. Two end caps



EM CDEs during wrapping and attachment of end caps



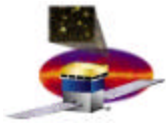


# CDE Design Drivers

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Design Feature	Design Driver
CsI(Tl) crystal	Active calorimeter over broad dynamic range Low energy threshold High stopping power for EM showers
Crystal surface treatment (light taper)	Position sensitivity Reliable energy measurement
Photodiode readout	Low-power, low-mass, small, reliable readout High light yield (= low E threshold) with CsI(Tl)
Two dual photodiodes	Large dynamic range Redundancy for energy measurement Position measurement
VM2000 wrapper	High light yield (= low E threshold) Stable wrap, easy to handle
End caps	Stable attachment within cell



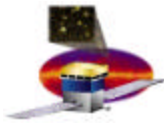


## Since PDR ...

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- ❑ Processes defined since PDR
  - Bonding of PDA to xtal
    - CTE mismatch between PDA and xtal causes stress in bond
      - Hard epoxies fail, silicones (without primer) don't adhere
    - Need soft, flexible bond with strong adhesion
    - Solution: Silicone elastomer with primer. Bond laid up in mold that defines geometry.
  - Wrapping of xtal
    - Material is 3M VM2000 non-metallic, specular, reflective film
      - High light yield, good optical properties
      - Material is stiff, difficult to fold or wrap
    - Solution: Mold in mandrel at 120C for 2 hrs at final shape



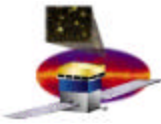


# Csl(Tl) crystals

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- ❑ **Csl(Tl) gives high light yield with PDs and good stopping power for EM showers**
  - **LAT CAL numerology**
    - 1536 crystals, each 326 mm x 26.7 mm x 19.9 mm
    - ~1200 kg of Csl
  - **Need to characterize each crystal: 100% inspection and test**
    - Dimensionally: completed CDE must fit in cell
    - Optically: xtal must have good light yield and taper
- ❑ **Procurement and testing are responsibility of GLAST Swedish Consortium**
  - **Institutions are Royal Institute of Technology (KTH), Stockholm University, and University of Kalmar**
  - **Responsibilities for crystal work:**
    - Kalmar developed test benches and procedures
    - Kalmar and KTH test the crystals (mechanical / optical performance)
    - KTH tests boule samples (radiation harness test)
- ❑ **Performance spec: LAT-DS-00820-03**



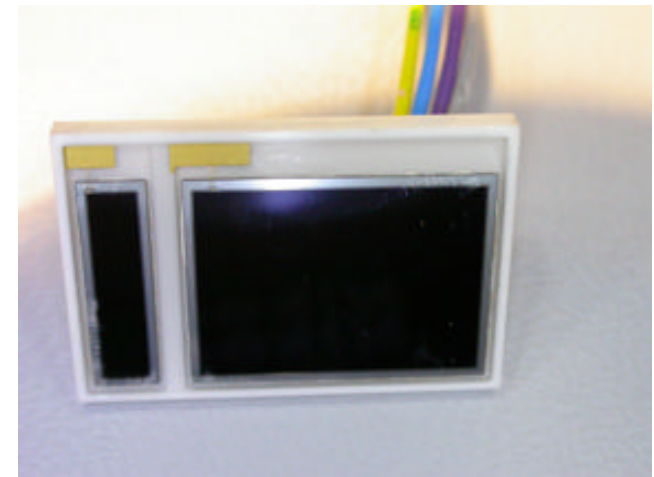


# Photodiodes

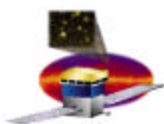
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- ❑ Spectral response well matched to CsI(Tl) scintillation
  - Very small mass, volume, and power
  - Rugged
  - Made commercially in large quantities
  - Total 3072 required in LAT CAL
  - Reliable devices: only lot sample testing is required
    - Capacitance
    - Dark current
    - Photosensitivity
- ❑ Procurement is joint responsibility of CEA/Saclay and NRL
- ❑ Testing and processing is responsibility of CEA/Saclay
  - Lead for testing at CEA is Philippe Bourgeois
- ❑ Spec: LAT-DS-00209-12

EM dual photodiode

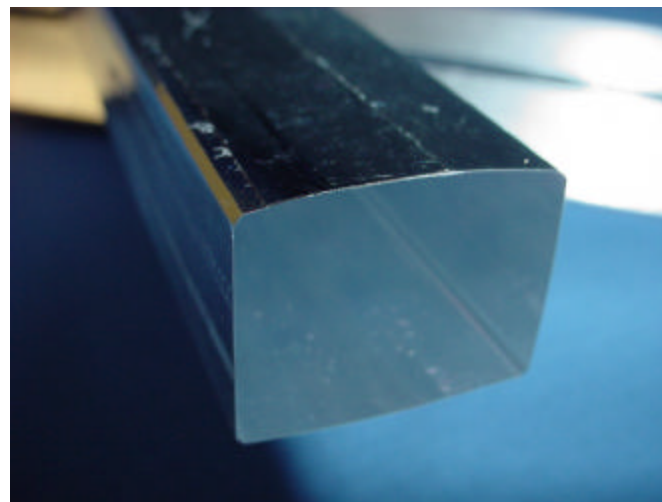




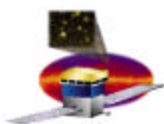


# Crystal Wrapper

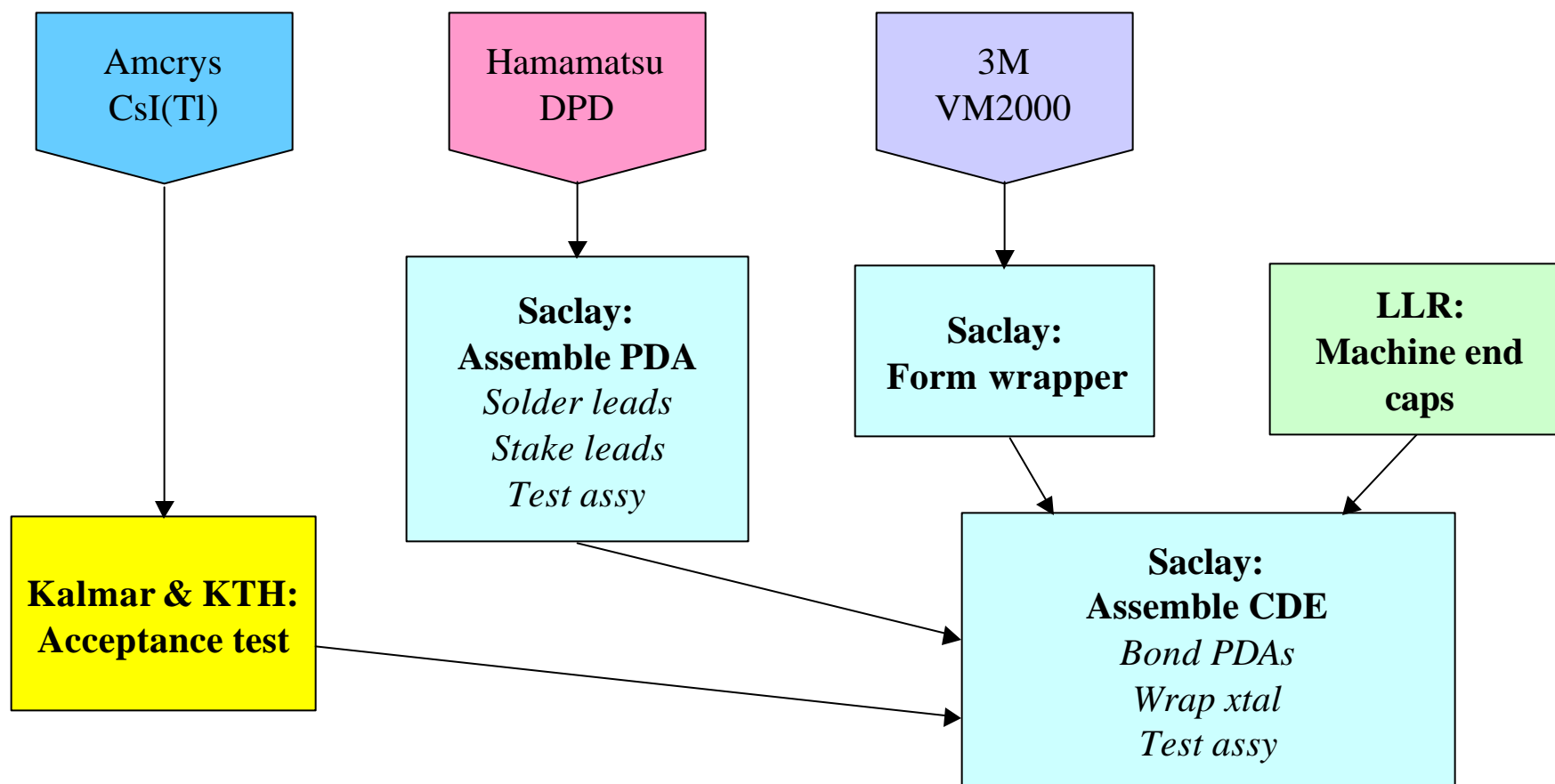
- ❑ Wrapper must be highly reflective
  - 3M VM2000 specular film
    - Gives 20-30% more light than standard diffusive white wraps (e.g. Tyvek, Tetratex)
    - Stable, rigid material will not wet xtal surface as Teflon-based wraps can (e.g. Tetratex)
  - Easy to form with hot molding (Swales)
    - Form VM2000 around aluminum mandrel in xtal form (with chamfers)
    - No loss in light yield or mechanical stability from hot molding
- ❑ Procurement and molding are responsibility of CEA/Saclay
- ❑ Molding/wrapping procedure: LAT-PS-00795-01





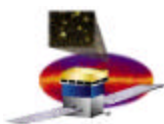


# Responsibilities



## □ Assembly flow for CDEs





# Schedule

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## ❑ Overview of schedule boundaries

Component	Task	Date
Crystal	First unit arrives at Kalmar Last unit ships to Saclay	Mar 2003 Dec 2003
DPD	First unit arrives Saclay Last PDA completed	Jun 2003 Dec 2003
Wrapper	Lot arrives at Saclay Final wrapper molded	Jun 2003 Apr 2004
End Cap	First lot manufactured at LLR Last lot ships to Saclay	Jul 2003 Nov 2003
CDE	Assembly of first lot begins Final lot completed	Jul 2003 Apr 2004

